This series provides short reviews of topics of interest to health sciences librarians.–Editor

Bibliometrics basics

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After an article is published, how much influence does it have? How can you measure the article's impact? *Bibliometrics* is the answer. Bibliometrics can be used for books, websites, monographs, conference proceedings, policy statements, even patents. In the health field, bibliometrics are mostly used to measure the influence or impact of research articles. Bibliometric methods estimate how much influence or impact a selected research article has on future research. It usually does this by counting the number of times the article is cited after it is published.

The concept is that if a research article, called the source item, is cited in a future article, then it must have influenced the researchers who produced the future (downstream) article. Being cited by another researcher indicates that the source researcher is having an impact on the science: The research product is being used by others to create even more information. If a source item is cited many times, it must mean that its publication was useful to many people and has high impact. High impact is felt to reflect high value.

A similar approach is used to evaluate journals. If a journal publishes an article that is cited many times downstream, then the journal did a good job selecting and publishing the source item. If a lot of the journal's articles are cited downstream, the journal has a high impact and is doing a *very* good job.

Judging the impact or value of research is difficult, and bibliometrics has become an important tool in the research world. It is important to both scientists and those who sponsor scientists. Citation analysis is the examination of downstream citation frequency and pattern. Along with impact factor of a journal and journal rank, these are the new indicators to evaluate scientist productivity and journal quality. These measures are tracked by the ISI (now Thomson Reuters) Web of Science, Scopus, and other resources.

CITATION COUNTS

The basic tool in bibliometrics is citation analysis. The most common tool of citation analysis is the citation count: the number of times a source item is cited. Bibliometrics does not exist without citation counts. (Qualitative analysis, which estimates the global impact of a publication, including changes in behavior and macroeconomics, is increasingly important but not mainstream yet.)

Web of Science is a popular source for citation counts. The most cited article in that database is a 1951 article describing a tool to measure protein, cited more than 305,000 times. A citation count that includes books has been produced by Google. Their data show the most cited article to be one that describes proteins in bacteriophages, a 1970 paper that has been cited more than 223,000 times [1].

JOURNAL IMPACT FACTOR

Citation counts can be used to produce a score for a journal. Journal impact factor (JIF), one of the common bibliometric measures, is simply the number of downstream citations that the average article in a journal gets. Its purpose is to help researchers understand the value of content published in a journal relative to other journals in a field: the higher the score, the greater the journal's impact. JIF has been known as the best and most objective tool available to determine the prestige of a journal; however, there are ongoing discussions about how to produce the score and how to interpret it. JIF may not be the best and only measure of journal quality.

SEARCHES FOR DOWNSTREAM CITATIONS

One question is where to look for the downstream citations. Database selection can affect scores. Should

only highly respected databases be used? What about citations in lay publications like the *New York Times* or *Scientific American*? There are web-based sources that attempt to measure this nonscience journal impact. Altmetrics ("alternate metric") is an alternative to traditional citation analysis. (Almetric is also the name of a company that provides altmetric analysis, including some free analyses <http://www.altmetric.com>.) Altmetrics is a newer approach that looks not only at citation counts, but also considers how many databases refer to the source article, what the number of article views or downloads is, and if the article is mentioned in the news media. It covers not only traditional publications, but also gray literature, research blogs, and other kinds of scholarly communication.

Other questions about searching for citations include: Should self-citation count? Over what time period should citations be counted: Two years? Five years? Two years suggests immediate impact, which may be more important.

SCORING SYSTEMS

Scoring systems are used not only to evaluate research journals and programs, but also can evaluate individual researchers. One system to evaluate individual researchers is the "H" model, named after its creator, Jorge Hirsch. It evaluates a set of the researcher's highly cited publications. The score is generally reported as the H-index, a dimensionless number, and is a count of citations derived by a certain formula. A higher number implies more influence or impact. H-index scores can also be used to evaluate groups of scientists, like a department or an institute.

Interpretation of scores can be contentious. Some disciplines have many researchers and more publications, while other disciplines have few researchers and few publications. In a discipline with few researchers, a truly major impact in the field may lead to only a few downstream citations. Comparing scores in fields like arts and humanities (that have few researchers) to scores in fields that have many more researchers can seem unfair. One service, *SNIP*, attempts to correct for this problem. Another question: Should a researcher get "extra points" for publishing in a high-impact journal compared to a lower-impact one?

Because finding downstream citations by hand is tedious and costly, automated systems are now widely used. Different scores for the same article can be based on different rules to collect downstream citations. Which system produces the most meaningful score? Academic institutions and funding agencies are trying to figure this out. And there are technical questions, such as, when aggregating scores to produce an average for one researcher, how can automated systems handle researchers with identical names?

SCIENTOMETRICS

A related field is scientometrics. (A journal by that name is published by Springer.) Scientometrics involves larger concepts, such as the impact of an entire research program or a field of science. It may include impact on economics, cultural patterns, and/or policy decisions. If an institute has sponsored a study or discovery, the institute can examine how the article or discovery led to other articles or discoveries, or other effects. A network linking these elements can be drawn, in which articles, for example, are nodes. Analysis of the network using high-level statistical models can produce insight about impact and connectivity. This can help the sponsoring institute understand the impact of the work it paid for.

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Interest in bibliometrics is increasing. The role of librarians in bibliometrics is evolving. Possible roles include helping find downstream citations, creating thesauri (taxonomies) to judge cross-discipline impact and to improve automated searches, helping to find the most appropriate score source, and helping to interpret different scoring models.

REFERENCE

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